

original constitution of the matter which was drawn together to form our planet. The actual character of all inorganic substances, as of all living creatures, is only consistent with the actual constitution and proportions of the various substances of which the earth is composed. Other proportions than the actual ones in the constituents of the atmosphere would have required an entirely different organisation in all air-breathing animals, and probably in all plants. With any considerable difference in the quantity of water either in the sea or distributed as vapour, vast changes in the constitution of living creatures must have been involved. Without oxygen, hydrogen, nitrogen, or carbon, what we term life would have been impossible. But such speculations need not be extended.

The substances of which the earth is now composed are identical with those of which it has always been made up; so far as is known it has lost nothing and has gained nothing, except what has been added in extremely minute quantities by the fall of meteorites. All that is or ever has been upon the earth is part of the earth, has sprung from the earth, is sustained by the earth, and returns to the earth; taking back thither what it withdrew, making good the materials on which life depends, without which it would cease, and which are destined again to enter into new forms, and contribute to the ever onward flow of the great current of existence.

The progress of knowledge has removed all doubt as to the relation in which the human race stands to this great stream of life. It is now established that man existed on the earth at a period vastly anterior to any of which we have records in history or otherwise. He was the contemporary of many extinct mammalia at a time when the outlines of land and sea, and the conditions of climate over large parts of the earth, were wholly different from what they now are, and our race has been advancing towards its present condition during a series of ages for the extent of which ordinary conceptions of time afford no suitable measure. These facts have, in recent years, given a different direction to opinion as to the manner in which the great groups of mankind have become distributed over the areas where they are now found; and difficulties once considered insuperable become soluble when regarded in connection with those great alterations of the outlines of land and sea which are shown to have been going on up to the very latest geological periods. The ancient monuments of Egypt, which take us back perhaps 7,000 years from the present time, indicate that when they were erected the neighbouring countries were in a condition of civilisation not very greatly different from that which existed when they fell under the dominion of the Romans or Mahometans hardly 1,500 years ago; and the progress of the population towards that condition can hardly be accounted for otherwise than by prolonged gradual transformations going back to times so far distant as to require a geological rather than an historical standard of reckoning.

Man, in short, takes his place with the rest of the animate world, in the advancing front of which he occupies so conspicuous a position. Yet for this position he is indebted not to any exclusive powers of his own, but to the wonderful compelling forces of nature which have lifted him entirely without his knowledge, and almost without his participation, so far above the animals of whom he is still one, though the only one able to see or consider what he is.

For the social habits essential to his progress, which he possessed even in his most primitive state, man is without question dependent on his ancestors, as he is for his form and other physical peculiarities. In his advance to civilisation he was insensibly forced, by the pressure of external circumstances, through the more savage condition, in which his life was that of the hunter, first to pastoral and then to agricultural occupations. The requirements of a population gradually increasing in numbers could only be met by a supply of food more regular and more abundant than could be provided by the chase. But the possibility of the change from the hunter to the shepherd or herdsman rested on the antecedent existence of animals suited to supply man with food, having gregarious habits, and fitted for domestication, such as sheep, goats, and horned cattle; for their support the social grasses were a necessary preliminary, and for the growth of these in sufficient abundance land naturally suitable for pasture was required. A further evasion of man's growing difficulty in obtaining sufficient food was secured by aid of the cereal grasses, which supplied the means by which agriculture, the outcome of pastoral life, became the chief occupation of more civilised generations. Lastly, when these increased facilities for providing food were in turn overtaken by the

growth of the population, new power to cope with the recurring difficulty was gained through the cultivation of mechanical arts and of thought, for which the needful leisure was for the first time obtained when the earliest steps of civilisation had removed the necessity for unremitting search after the means of supporting existence. Then was broken down the chief barrier in the way of progress, and man was carried forward to the condition in which he now is.

It is impossible not to recognise that the growth of civilisation, by aid of its instruments, pastoral and agricultural industry, was the result of the unconscious adoption of defences supplied by what was exterior to man, rather than of any truly intelligent steps taken with forethought to attain it; and in these respects man, in his struggle for existence, has not differed from the humbler animals or from plants. Neither can the marvellous ultimate growth of his knowledge, and his acquisition of the power of applying to his use all that lies without him, be viewed as differing in anything but form or degree from the earlier steps in his advance. The needful protection against the foes of his constantly increasing race—the legions of hunger and disease, infinite in number, ever changing their mode of attack or springing up in new shapes—could only be attained by some fresh adaptation of his organisation to his wants, and this has taken the form of that development of intellect which has placed all other creatures at his feet and all the powers of nature in his hand.

The picture that I have thus attempted to draw presents to us our earth carrying with it, or receiving from the sun or other external bodies, as it travels through celestial space, all the materials and all the forces by help of which are fashioned whatever we see upon it. We may liken it to a great complex living organism, having an inert substratum of inorganic matter on which are formed many separate organised centres of life, but all bound up together by a common law of existence, each individual part depending on those around it, and on the past condition of the whole. Science is the study of the relations of the several parts of this organism one to another, and of the parts to the whole. It is the task of the geographer to bring together from all places on the earth's surface the materials from which shall be deduced the scientific conception of nature. Geography supplies the rough blocks wherewith to build up that grand structure towards the completion of which science is striving. The traveller, who is the journeyman of science, collects from all quarters of the earth observations of fact, to be submitted to the research of the student, and to provide the necessary means of verifying the inductions obtained by study or the hypotheses suggested by it. If therefore travellers are to fulfil the duties put upon them by the division of scientific labour, they must maintain their knowledge of the several branches of science at such a standard as will enable them thoroughly to apprehend what are the present requirements of science, and the classes of fact on which fresh observation must be brought to bear to secure its advance. Nor does this involve any impracticable course of study. Such knowledge as will fit a traveller for usefully participating in the progress of science is now placed within the reach of everyone. The lustre of that energy and self-devotion which characterise the better class of explorers will not be dimmed by joining to it an amount of scientific training which will enable them to bring away from distant regions enlarged conceptions of other matters besides mere distance and direction. How great is the value to science of the observations of travellers endowed with a share of scientific instruction is testified by the labours of many living naturalists. In our days this is especially true; and I appeal to all who desire to promote the progress of geographical science as explorers, to prepare themselves for doing so efficiently, while they yet possess the vigour and physical powers that so much conduce to success in such pursuits.

FRENCH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THERE seems to have been few papers of striking importance read at the Nantes meeting of this Association, though the large number and the solid character of most of the papers show that the scientific activity of France continues to be well sustained. The following are some of the principal papers read in the various sections:—

Zoology.—M. Bureau presented some very interesting observations on the *Aquila pennata*, Brehm and Briss, which he has had the opportunity of closely observing. He is convinced that all the varieties belong to two types, which he has named the white

and the black types. Pairs belong sometimes to one type, very often to two different types; generally the young are completely black or completely white.

M. Giard gave an account of his researches on some controverted points in the embryogeny of the *Ascidians*, more especially *Molgula socialis*, which he has studied in the zoological laboratory of Wimereux. He has been able to supplement and correct in several respects the conclusions of previous observers. M. Giard also, after long research into the embryogeny of animals belonging to the various classes into which Cuvier divided the *Articulata* and *Mollusca*, proposed another limitation of these two groups. Another paper by the same was concerned with the embryogeny of the pectinibranchiate *Gastropoda*.

Prof. Sirodot described in detail the results of his researches on Elephants. M. Sirodot remarked that, having had at his disposal a very large number of teeth, he had been able not only to correct the errors committed by Falconnet and De Blainville, but, moreover, to feel confident that the different species of *Elephas* hitherto described as closely allied to the Mammoth have no value whatever. There are a multitude of intermediate forms connecting the *Elephas primigenius* with *Elephas indicus*.

M. Lortet, while in Syria, made some investigations into the organisation and reproduction of fibrous sponges. He has been able to prove the presence and to follow the formation of the male and the female egg. Apart from these genital products, he did not meet, in the sponges which he examined, any other cellular element. M. Lortet did not observe, moreover, any canals running into the great canal of the ovule, canals referred to by a large number of zoologists. M. Lortet also described his observations on the very peculiar fauna of the Lake of Tiberias. This fauna appears to indicate a former communication between the waters of the lake and those of the sea.

Physics.—M. Cornu indicated a very simple process for determining with accuracy the focal distance and the principal points of lenses.

M. Merget explained the very interesting results of his researches on the thermo-diffusion of porous and humid pulverulent bodies. A thermo-diffuser is generally a porous vessel, filled with an inert powder, in the middle of which is a glass tube or a metallic tube riddled with holes. On heating such an apparatus, after having moistened it, steam is disengaged in abundance through the porous substance, while dry air traverses the apparatus in an inverse direction, and escapes by the tube. If this escape be prevented, there is produced a pressure which reached three atmospheres at a dull red heat. If the pulverulent mass or the porous body ceases to be moist, no gas escapes. The author did not explain the fact, but he showed that the explanation of it given by M. De la Rive cannot be accepted. M. Merget is convinced that there is here a thermo-dynamic phenomenon. Thermo-diffusion must play an important part in the gaseous exchanges of vegetable life; the author showed this by taking a leaf of *Nelumbium* as a thermo-diffuser.

M. Gripon communicated to the Section and repeated various experiments which he had performed with films of collodion. In receiving upon a Savart polariscope light polarised by a lamina of collodion, we have there systems of fringes, one normal, the other due to phenomena of secondary interference. By illuminating a film of collodion with the light reflected by a second film, we easily obtain fringes of interference, as in the experiment of Brewster. Collodion films are very diathermanous for luminous heat; they are less so for dark heat.

M. Mascart showed some very curious experiments on the condensation resulting from the expansion of moist air. If a little water is placed in the bottom of a perfectly clean flask, closed by a glass tube terminated by an india-rubber syphon bag, we have a closed space, which soon becomes saturated with moisture. By pressing on the bag the temperature rises, and there can be no condensation. But by allowing the bag to resume, by its elasticity, its original form, the air expands, is consequently cooled, and, contrary to what is usually observed, no condensation takes place. To produce the condensation ordinarily observed, it is sufficient to introduce into the flask some unfiltered air, while filtered air produces no effect. In the same way very beautiful clouds are obtained by introducing a little tobacco smoke, or gases resulting from any kind of combustion. These experiments may be of some use in explaining the formation of clouds.

M. Deprez presented an ingenious electric chronograph, intended to estimate by the graphic method intervals of time extremely small, as the duration of a shock.

M. Cornu explained his experiments on the rate of light, by the method of M. Fizeau. (See NATURE, vol. xi. p. 274).

Dr. Moreau explained some points in his investigations on the swim-bladder of fishes, and showed particularly that in proportion as a fish sinks the effort which it must make diminishes.

M. Dufet read a paper on his researches into the electric conductivity of pyrites.

In the Section of *Geology and Mineralogy*, most of the papers referred to local topics. Of those of general interest we mention the following:—M. Henry Dufet described his experiments on the thermic conductivity of certain schistose rocks, from which he drew some interesting conclusions regarding the deformations of the fossils contained in such rocks. M. Charles Vélain read a paper on his exploration of the islands of St. Paul and Amsterdam, while on the expedition for observing the Transit of Venus. M. Lory presented some considerations on the dislocation of rocks in mountainous countries.

Botany.—In this section M. Sirodot gave an account of his researches on the classification and development of *Batrachospermum*, and M. de Lanessan spoke on the floral organogeny of *Zostera*.

M. J. Chatin described the results of his histological and histogenic researches on the interior leaf glands and some analogous productions. After having studied the mode of formation of the structure of these various organs in many families, he draws the following conclusions:—1. The interior leaf glands originate always in the mesophyll. 2. These glands are formed by differentiation from a cellule in which multiplication by division is rapidly produced, so that except in some Lauraceæ the gland is always formed, in its perfect state, from a cellular mass, more or less considerable. 3. The products of secretion are constantly forming in the cellules proper of the gland. 4. The elements of the latter are re-absorbed from the centre to the circumference, and thus form a reservoir where the product of secretion is amassed. 5. In certain plants, and by an analogous phenomenon, there may be formed in the leaf true secreting canals. 6. The leaf-glands are almost constantly situated in the vicinity of the fibro-muscular bundles. 7. In many plants there exist at different points of the stalk, of the branches, and of the petioles, certain productions on the whole comparable to the interior leaf-glands.

M. Merget gave the result of his researches on the interchange of gases between plants and the atmosphere. He concluded with the following statements:—1. The means by which the interchange of gases is effected in plants are the stomata and accidental openings; it is by diffusion in the stomata, and not by dialysis through the cuticle, that exterior gases penetrate into the interior of a plant, and that internal gases escape. 2. The entry of atmospheric gases is due to the action of the physical force produced by the phenomena of gaseous thermo-diffusion. M. Merget concluded by some interesting details on the function of chlorophyll.

M. Baillon read a very interesting communication on the Amentacæ.

In the Section of *Anthropology*, we note the following papers:—Dr. Lagneau read a careful and elaborate memoir on the ethnogeny of the populations of the N. W. of France, in which he reviewed the various peoples which have contributed to the formation of the former and present population of the region comprised between the sea, the Saône, and the Loire.—M. Chauvet read a report relative to the excavations undertaken by the Archaeological Society of Charente, in the tumuli on a woody plateau near a Roman road, and entered into details of a nature to clear up certain controverted points of prehistoric archaeology. From the objects found in these explorations, M. Chauvet develops a doctrine according to which there was no gap between the various civilisations from an industrial point of view.

As usual, a very large number of papers belong to the Section of Medical Sciences; some of these are of more than merely technical interest, but our space prevents us from referring to them in detail. A full report of the proceedings will be found in the *Revue Scientifique* for August 28 and following weeks.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—DETROIT MEETING

THE American Association for the Advancement of Science held its twenty-fourth annual meeting at Detroit, Mass., from Aug. 11 to 17 inclusive. Some of